

I claim:

1. (Amended) A method for effecting movements of [moving] a [displayed] displayable object on [an interactive] a computer graphic display having vertical and horizontal Cartesian coordinate axes in response to one of pitch and yaw rotations of an input device, the method comprising: [the steps of:]

[detecting the pitch or yaw rotation of the device;]

sensing an inertial response to pitch or yaw rotation of the input device to produce [provide] a signal [indicative of] proportional to the at least one of the pitch and yaw rotations of the input device; and

[in response to the signal indicating the detected pitch or yaw movement of the input device,] moving the [displayed] displayable object a distance in a plane defined by the vertical and horizontal axes on the computer graphic display in substantially continuous proportionality to the signal and [,the displayed object being moved] translationally along one of the vertical and horizontal axes in substantially a single direction for each direction in which the input device is rotated.

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2. (Amended) [A] The method according to [for effecting translational movements of a displayed object on an interactive computer graphic display as in] claim 1 further comprising: [the steps of:]

selectively inhibiting the input device from producing [a] the signal to permit reorientation of the input device without substantially proportional translational movement of the displayed object on the computer graphic display; and

selectively enabling the input device for producing the signal in response to said one of pitch and yaw rotations of the input device.

3. (Amended) A method for [providing a signal to effect] effecting translational movements of a [displayed] displayable object on [an interactive] a computer graphic display using an input device including an inertial gyroscopic element that is manually movable in free space, the method comprising: [the steps of:]

supporting the inertial gyroscopic element with respect to the input device;

actuating the gyroscopic element to exhibit inertia relative to an inertial axis;

detecting rotational movement of the input device relative to the inertial axis of the gyroscopic element; and

[providing] producing a signal [responsive] substantially proportional to the rotation of the input device relative to the inertial axis for effecting translational movements of the [displayed] displayable object on the computer graphic display in substantially continuous proportionality to the signal and in a single direction for each direction in which the input device is rotated.

✓ 4. (Amended) A method for effecting [providing a signal to effect] translational movements of a [displayed] displayable object on [an interactive] a computer graphic display using an inertial input device that is manually movable in free space, the method comprising: [the steps of:]

detecting[, by inertial means,] rotational movement of the input device about one axis; and

[providing] producing a first signal substantially proportional [responsive] to the rotation of the input device about the one axis for effecting translational movements of the [displayed] displayable object on the computer graphic display in substantially continuous proportionality to the first signal and in a single direction for each direction in which the input device is rotated.

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5. (Amended) [A] The method according to claim 4 for [providing signals to effect] effecting the translational movements on [an interactive] the computer graphic display along at least one of first and second coordinate axes[,] using the inertial input device, the method further comprising: [the steps of:]

detecting[, by inertial means,] rotational movement of the input device about a second axis not parallel to the one axis;

[providing] producing a second signal [responsive] substantially proportional to the rotation of the input device about the second axis[; and] for effecting translational movements [on the display] of the displayable object along a first coordinate axis of the computer graphic display in substantially continuous proportionality [response] to the first signal and in a single direction for each direction in which the input device is rotated about the one axis, or along a second coordinate axis of the computer graphic display in [response] substantially continuous proportionality to the second signal and in a single direction for each direction in which the input device is rotated about the second axis.

6. (Amended) [A graphical] An input device for providing a signal to effect translational movements of a [displayed] displayable object on [an interactive] a computer graphic display, comprising:

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a hand-held housing adapted for manual movement in free space; and
an inertial gyroscopic element mounted with respect to said housing[,
for providing a signal, in response] and responsive to rotation of the housing
about an axis for producing a signal substantially proportional to said
rotation for effecting[, to effect] translational movements of the [displayed]
displayable object on [an interactive] the computer graphic display in
substantially continuous proportionality to the signal and in a single
direction for each direction in which the [device] housing is rotated.

7. (Amended) [A graphical] The input device [for providing a
signal to effect translational movements of a displayed object on an
interactive computer graphic display as in] according to claim 6[,] wherein
the gyroscopic element comprises an angular position gyroscope.

8. (Amended) [A graphical] The input device [for providing a signal to
effect translational movement of a displayed object on an interactive computer
graphic display as in] according to claim 7[,] wherein the angular position
gyroscope comprises:

an inertial gyroscopic element disposed to spin about a spin axis;
a gimbal supporting the gyroscopic element with respect to the housing; and
a sensor disposed with respect to the gimbal and the housing for producing
said signal in response to rotation of the housing relative to the spin axis.

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9. A graphical input device for providing a signal to effect the translational movement of a cursor on an interactive computer graphic display comprising:

- a housing adapted for manual movement in free space;
- an inertial gyroscopic element disposed to spin about one spin axis;
- a gimbal supporting the gyroscopic element with respect to the housing; and
- a sensor disposed with respect to the gimbal and the housing for producing a signal, in response to rotation of the housing relative to one spin axis, to effect translational movement of the cursor in substantially a single direction for each direction in which the housing is rotated.

10. A graphical input device for providing a signal to effect the translational movement of a cursor on an interactive computer graphic display as in claim 9 further comprising a manually operable switch mounted with respect to the housing and operatively connected for selecting inhibiting the graphical input device from producing a signal to permit reorientation of the graphical input device without translational movement of the cursor in response to said signal, and for selectively enabling the graphical input device for producing said signal in response to rotational movement of the housing relative to the spin axis of the gyroscopic element.

11. A graphical input device for providing signals to effect translational movement of a cursor on an interactive computer graphic display as in claim 10 wherein the signal is produced in response to one of pitch and yaw rotational movement of the housing for effecting the translational movement of the cursor along one of vertical and horizontal Cartesian coordinate axes of the display in response to the signal.

12. An interactive computer graphic display system comprising a graphical input device as in claim 11 and further comprising a circuit coupled to the display for effecting the translational movement of the cursor along one of the horizontal and vertical Cartesian coordinate axes of the display in response to the signal.

13. (Amended) A method for controlling translational movements of a [displayed] displayable object on [an interactive] a computer graphic display having vertical and horizontal Cartesian coordinate axes in response to one of pitch and yaw rotations of an input device, the method comprising:
[the steps of:]

detecting the pitch or yaw rotation of the input device;

sensing an inertial response to [provide] produce a signal [indicative of] substantially proportional to at least one of the pitch and yaw rotations of the input device; and

in response to the signal, [detecting pitch or yaw movement of the input device,] moving the [displayed] displayable object a substantially continuously proportional distance in a plane defined by the vertical and horizontal axes on the computer graphic display without rotating the [displayed] displayable object.

✓14. (Amended) [A graphical] An input device for providing a signal to manipulate translational movements of a [displayed] displayable object on [an] a computer graphic display, comprising:

a hand-held housing adapted for manual movement in free space; and
an inertial gyroscopic element mounted with respect to said housing[, for providing a signal, in response] and responsive to rotation of the housing about an axis for producing a signal substantially proportional to said rotation for manipulating [to manipulate] translational movements of the displayable [displayed] object on the [an interactive] computer graphic display in substantially continuous proportionality to the signal without causing the [displayed] displayable object to be rotated.

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15. (Amended) A method for [providing] producing a signal to control translational movements of a displayable [displayed] object on [an interactive] a computer graphic display using an input device including an inertial gyroscopic element that is manually movable in free space, the method comprising: [the steps of:]

supporting the inertial gyroscopic element with respect to the input device;

actuating the gyroscopic element to exhibit inertia relative to an inertial axis;

detecting rotational movement of the input device relative to the inertial axis of the gyroscopic element; and

[providing] producing a signal substantially proportional [responsive] to the rotation of the input device relative to the inertial axis for controlling translational movements of the [displayed] displayable object in substantially continuous proportionality to the signal without causing the [displayed] displayable object to be rotated.

16. (New) An interactive computer graphic display system comprising an input device according to claim 6 and further comprising a circuit coupled to the computer graphic display for effecting the translational movement of a displayable object along one of horizontal and vertical

Cartesian coordinate axes of the computer graphic display in substantially continuous proportionality to the signal.

/ 17. (New) A method for effecting movements of a displayable object on a graphic display having vertical and horizontal Cartesian coordinate axes in response to one of pitch and yaw rotations of an input device, the method comprising:

sensing gravitational orientation;

sensing an inertial response to pitch or yaw rotation of the input device relative to the gravitational orientation to produce a signal indicative of at least one of the pitch and yaw rotations of the input device relative to the gravitational orientation; and

moving the displayable object a distance in a plane defined by the vertical and horizontal axes on the computer graphic display translationally along one of the vertical and horizontal axes in substantially a single direction for each direction in which the input device is rotated.

18. (New) The method according to claim 17, further comprising:

selectively inhibiting the input device from producing the signal to permit reorientation of the input device without translational movement of the displayed object on the computer graphic display; and

selectively enabling the input device for producing the signal in response to said one of pitch or yaw rotations of the input device relative to the gravitational orientation.

✓ 19. (New) A method for effecting movements of a displayable object on a graphic display having vertical and horizontal Cartesian coordinate axes in response to one of pitch and yaw rotations of an input device including an inertial element, the method comprising:

sensing gravitational orientation;

sensing an inertial response to pitch or yaw rotation of the inertial element relative to the gravitational orientation to produce a signal indicative of at least one of the pitch and yaw rotations of the device relative to the gravitational orientation; and

moving the displayable object a distance in a plane defined by the vertical and horizontal axes on the computer graphic display translationally along one of the vertical and horizontal axes in substantially a single direction for each direction in which the input device is rotated.

20. (New) The method according to claim 19, further comprising:

selectively inhibiting the inertial element from producing the signal to permit reorientation of the input device without translational movement of the displayed object on the computer graphic display; and

selectively enabling the inertial element for producing the signal in response to said one of pitch or yaw rotations of the input device relative to the gravitational orientation.

21. (New) A method for effecting translational movements of a displayable object on a computer graphic display using an input device including an inertial gyroscopic element that is manually movable in free space, the method comprising:

supporting the inertial gyroscopic element with respect to the input device;

actuating the gyroscopic element to exhibit inertia relative to an inertial axis;

sensing gravitational orientation;

detecting rotational movement of the input device about the inertial axis of the gyroscopic element relative to the gravitational orientation; and

producing a signal responsive to the rotation of the input device about the inertial axis relative to the gravitational orientation for effecting translational movements of the displayable object on the computer graphic display in substantially a single direction for each direction in which the input device is rotated.

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✓ 22. (New) A method for effecting translational movements of a displayable object on a computer graphic display using an inertial input device that is manually movable in free space, the method comprising:

sensing gravitational orientation;

detecting rotational movement of the input device about one axis relative to the gravitational orientation; and

producing a first signal substantially proportional to the rotation of the input device about the one axis for effecting translational movements of the displayable object on the computer graphic display in substantially continuous proportionality to the first signal and in a single direction for each direction in which the input device is rotated.

23. (New) The method according to claim 22 for effecting the translational movements on the computer graphic display along at least one of first and second coordinate axes using the inertial input device, the method further comprising:

detecting rotational movement of the input device about a second axis not parallel to the one axis and relative to the gravitational orientation;

producing a second signal responsive to the rotation of the input device about the second axis for effecting translational movements of the displayable object along a first coordinate axis of the computer graphic

display in substantially continuous proportionality to the first signal and in a single direction for each direction in which the input device is rotated about the one axis, or along a second coordinate axis of the computer graphic display in response to the second signal and in a single direction for each direction in which the input device is rotated about the second axis.

24. (New) An input device for producing a signal to effect translational movements of a displayable object on a computer graphic display, comprising:

a hand-held housing adapted for manual movement in free space;
sensing apparatus in the housing to detect gravitational orientation;

and

an inertial gyroscopic element mounted with respect to said housing and responsive to rotation of the housing about an axis relative to the gravitational orientation to produce a signal indicative of said rotation for effecting translational movements of the displayable object on the computer graphic display in substantially a single direction for each direction in which the housing is rotated.

25. (New) An input device according to claim 24, wherein the sensing apparatus detects substantially vertical gravitational orientation independent of the orientation of the housing in free space.

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26. (New) The input device according to claim 25, wherein the sensing apparatus comprises:

an inertial gyroscopic element disposed to spin about a spin axis;
a gimbal supporting the gyroscopic element with respect to the housing and including a center of mass eccentric the spin axis; and
a sensor communicating with the gimbal for producing an output indicative of the gravitational orientation.

27. (New) An input device for producing a signal to effect translational movement of a displayable object on a graphic display, the input device comprising:

a hand-held housing adapted for manual movement in free space;
an inertial gyroscopic element disposed to spin about one spin axis;
a gimbal supporting the gyroscopic element with respect to the housing and including a center of mass eccentric the spin axis;
a first sensor disposed with respect to the gimbal and the housing and responsive to rotation of the housing relative to one spin axis for producing a signal substantially proportional to said rotation for effecting translational movement of the displayable object in substantially continuous proportionality to the signal and in a single direction for each direction in which the housing is rotated; and

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a second sensor in communication with the gimbal for producing an output indicative of gravitational orientation, independent of the orientation of the housing in free space.

28. (New) An interactive computer graphic display system comprising an input device as in claim 24 and further comprising a circuit coupled to the display for effecting translational movement of the displayable object along one of horizontal and vertical Cartesian coordinate axes of the computer graphic display in response to the rotation of the housing relative to the gravitational orientation.

29. (New) An input device for manipulating translational movements of a displayable object on a computer graphic display, comprising:

a hand-held housing adapted for manual movement in free space;
sensing apparatus in the housing to detect gravitational orientation;
and

an inertial element mounted with respect to said housing and responsive to rotation of the housing about an axis relative to gravitational orientation for producing a signal indicative of said rotation for manipulating translational movements of the displayable object on the computer graphic display without causing the displayable object to be rotated.

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30. (New) A method for producing a signal to control translational movements of a displayable object on a computer display using an input device including an inertial element that is manually movable in free space, the method comprising:

supporting the inertial element with respect to the input device;

sensing gravitational orientation of the input device in free space;

sensing inertia of the input device relative to the sensed gravitational orientation;

detecting rotational movement of the input device with respect to an inertial axis of the inertial element relative to the gravitational orientation;

and

producing a signal substantially proportional to the rotation of the input device about the inertial axis relative to the gravitational orientation for controlling translational movements of the displayable object in response to the signal without causing the displayable object to be rotated.

31. (New) The method according to claim 5 further comprising:

selectively inhibiting producing at least one of the first and second signals to permit reorientation of the device without translational movement of the displayable object on the computer display; and

selectively enabling producing the at least one of the first and second signals in response to rotational movement of the input device about the corresponding one and second axes.

32. (New) The input device according to claim 6 comprising:
a switch mounted on the housing for manual activation to one operating state for selectively inhibiting producing said signal, and for actuation to another operating state for enabling producing said signal in response to said rotation of the housing.

33. (New) An input device for producing a signal to manipulate translational movements of a displayable object on a computer graphic display, comprising:

a hand-held housing adapted for manual movement in free space;
an inertial element mounted with respect to the said housing and responsive to rotation of the housing with respect to an inertial axis of the inertial element for producing a signal indicative of said rotation for manipulating translational movements of the displayable object on the computer graphic display; and

a switch mounted on the housing for manual actuation to one operating state for selectively inhibiting producing said signal, and for

actuation to another operating state for enabling producing said signal in response to said rotation.

34. (New) The method according to claim 21 further comprising:
selectively inhibiting producing said signal to permit reorientation of the input device without translational movement of the displayable object on the computer graphic display; and

35. (New) The method according to claim 23 further comprising:
selectively inhibiting producing at least one of the first and second signals to permit reorientation of the input device without translational movement of the displayable object on the computer graphic display; and
selectively enabling producing at least the one of the first and second signals in response to said rotation of the input device about the corresponding one and second axes.

36. (New) The input device according to claim 24 comprising:
a switch mounted on said housing for manual actuation to one operating state for selectively inhibiting producing said signal, and for actuation to another operating state for enabling producing said signal in response to said rotation of the housing.

37. (New) The input device according to claim 29 comprising:

a switch mounted on said housing for manual actuation to one operating state for selectively inhibiting producing said signal, and for actuation to another operating state for enabling producing said signal in response to said rotation of the housing.

38. (New) The method according to claim 30, further comprising: selectively inhibiting producing said signal to permit reorientation of the input device without translational movement of the displayable object on the computer graphic display; and

selectively enabling producing said signal in response to said rotation of the input device.

39. (New) An input device for producing a signal to effect translational movements of a displayable object on a computer graphic display, comprising:

an inertial gyroscopic means adapted for manual movement in free space for producing a signal substantially proportional to rotation of the housing about an axis to effect translational movements of the displayable object on the computer graphic display in substantially continuous proportionality to the signal and in a single direction for each direction in which the inertial gyroscopic means is rotated.

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40. (Amended) [A graphical] The input device according to claim 39 wherein the inertial gyroscopic means comprises an angular position gyroscope.

41. (New) The input device according to claim 39 further comprising:

switch means mounted with respect to the inertial gyroscopic means for selectively inhibiting producing said signal to permit reorientation of the input device without translational movement of the displayable object in response to said signal, and for selectively enabling the input device to produce said signal.

42. (New) An interactive computer graphic display system comprising an input device as in claim 39 and further comprising circuit means for effecting translational movement of the displayable object along one of horizontal and vertical Cartesian coordinate axes of the computer graphic display in substantially continuous proportionality to the signal.

43. (New) An input device according to claim 39 comprising: sensing means for detecting gravitational orientation; and said inertial gyroscopic means produces said signal indicative of said rotation relative to the gravitational orientation.

44. (New) An interactive computer graphic display system comprising an input device as in claim 43 and further comprising circuit means for effecting translational movement of the displayable object along one of horizontal and vertical Cartesian coordinate axes of the computer graphic display in response to the rotation of the housing relative to the gravitational orientation.

45. (New) An input device for manipulating translational movements of a displayable object on a computer graphic display, comprising:

hand-held housing means adapted for manual movement in free space;
sensing means in the housing means for detecting gravitational orientation; and

inertial means mounted with respect to said housing means and responsive to rotation of the housing means about an axis relative to gravitational orientation for producing a signal indicative of said rotation for manipulating translational movements of the displayable object on the computer graphic display without causing the displayable object to be rotated.

46. (New) The input device according to claim 39 comprising:

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switch means with the inertial gyroscopic means for manual activation to one operating state for selectively inhibiting producing said signal, and for actuation to another operating state for enabling producing said signal in response to said rotation of the housing.

47. (New) The input device according to claim 43 comprising:
switch means mounted with said sensing means and said inertial gyroscopic means for manual actuation to one operating state for selectively inhibiting producing said signal, and for actuation to another operating state for enabling producing said signal in response to said rotation.

48. (New) The input device according to claim 45 comprising:
switch means on said housing means for manual actuation to one operating state for selectively inhibiting producing said signal, and for actuation to another operating state for enabling producing said signal in response to said rotation of said housing means.

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